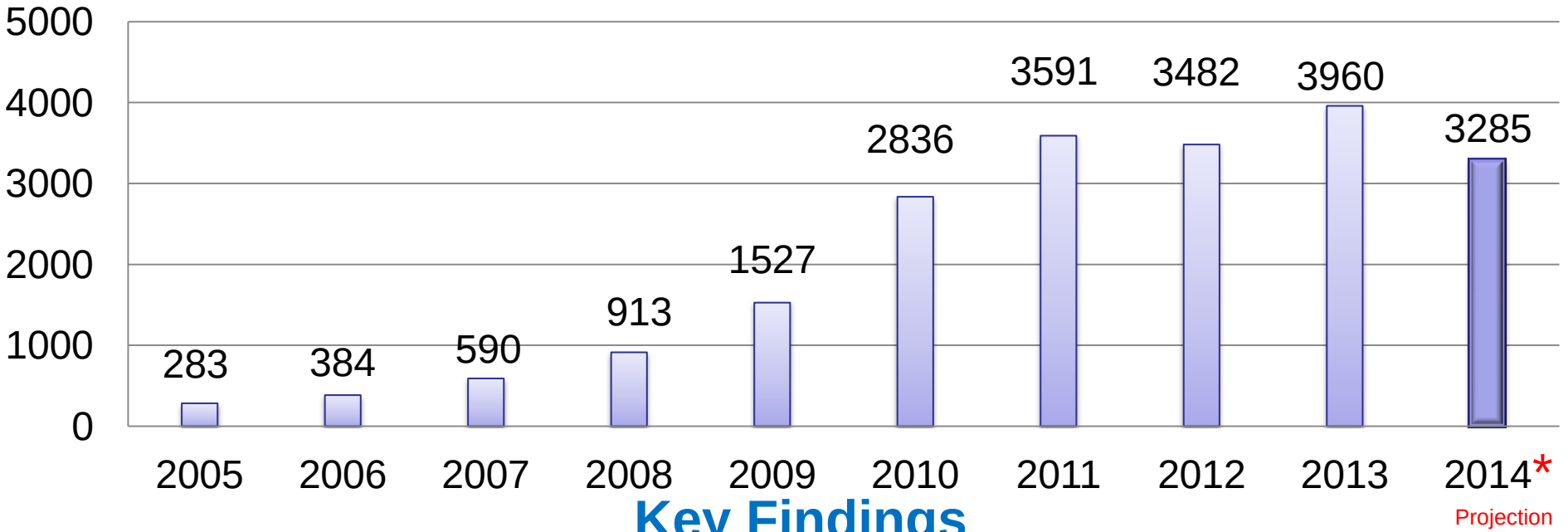
Dangers of Handheld Lasers to Aircraft

George H. Johnson
Supervisory Federal Air Marshal
FBI Criminal Investigative Division

2005 - 2013 Total Laser Events



Key Findings

Laser strikes averaged

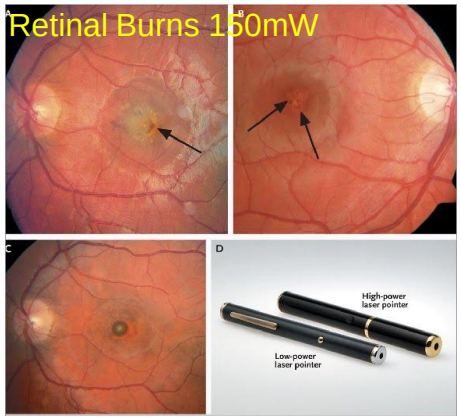
- 10 a day in 2011, 9.5 a day in 2012 and 11 a day in 2013.
- 2014: Laser strikes down to 9 a day largely the result of Public Awareness Efforts.*

Efforts towards mitigation:

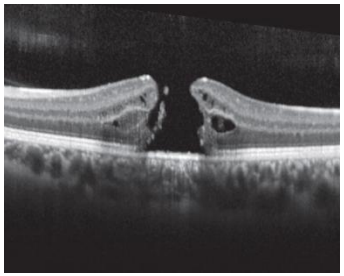
- **Passage of the *FAA Modernization and Reform Act of 2012* – 18 USC § 39 (a) (Aiming a laser pointer at an aircraft)**
- **Laser Strike Working Group outreach efforts**
- **Public Affairs Efforts (FBI outreach, FBI & FAA websites)**
- **11 Feb 2014 Regional Reward and Awareness Campaign:** Albuquerque, Chicago, Cleveland, Houston, Los Angeles, New York City, Philadelphia, Phoenix, Sacramento, San Antonio, San Juan, and the Washington Field Office.

Physical Reactions to Laser Illumination

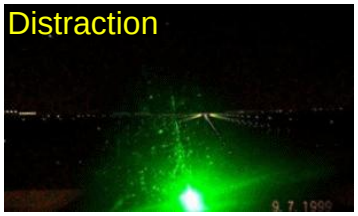
- Visible light spectrum physiological effects include:
  - Dazzle
  - After-Image Formation
  - Flash Blindness
  - Retinal Bruising
  - Irreversible Damage (particularly at close range)



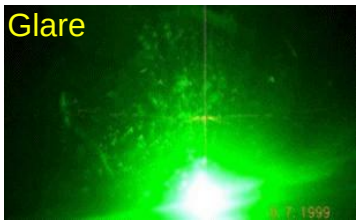
- Ultraviolet and Infrared physiological effects:
  - Retinal Bruising
  - Irreversible Damage



Macular perforation resulting from a 1000mW laser readily available on the internet for under $300.



- Eye and Safety hazards:
  - Distraction / Glare – Including loss of Night Vision
  - Disorientation – Ability to know location in 3D Space
  - Temporary (Flash) Blindness – with After images
  - Retinal Bruising (Temporary)
  - Permanent Blindness – Direct or Indirect skin, photochemical induced, and thermal Permanent Retinal Damage

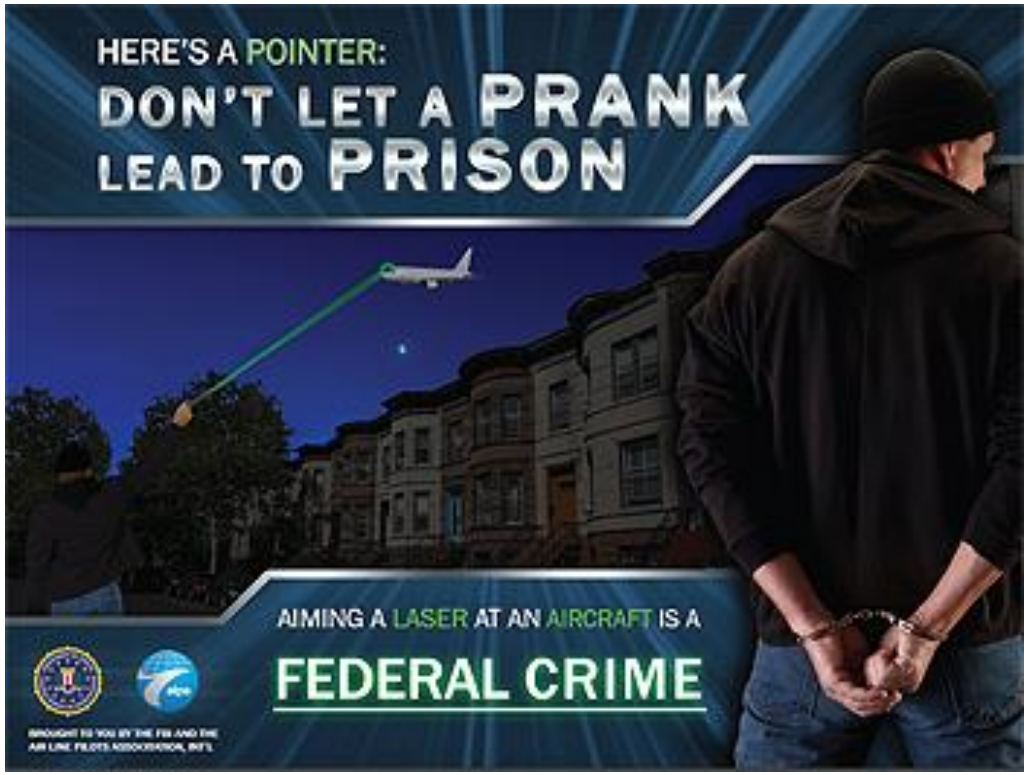


- Although no permanent injury has ever been reported to the FAA as a result of an aviation related laser strike:
  - There were 73 reports of eye injury in 2013, 38 in 2012.
- Alteration of flight path, procedures and /or schedules:
  - May cause aircraft to abort operations or procedures
  - May result in delays
  - May result in medical decertification
- Worst-Case Scenario = Crash*

*** (To Date, no airline crash has ever been attributed to a laser strike)**

Public Awareness Campaigns

- **Newark and Philadelphia FBI Field Offices, 9/19/12**
  - – FBI Newark and Philadelphia Field Offices conducted a Laser Strike Press Conference followed by a Public Service Announcement to advise the media on the extent of the problem, dangers, and penalties associated with commercial aircraft being targeted by handheld lasers.
  - – Effort contributed to the following reductions in laser strikes through year end: 43% NJ, 32% NY, & 45% PA.
- **FBI HQ Public Affairs, 10/05/12**
  - – FBI News Blog focused on the increase in laser strikes against aircraft followed by guidance to field offices on the procedures for opening cases involving laser attacks on aircraft.
- **FBI HQ Public Affairs, 02/11/14**
  - – 12 FBI offices participating in a two month program aimed at deterring people from aiming laser pointers at aircraft: Albuquerque, Chicago, Cleveland, Houston, Los Angeles, New York City, Philadelphia, Phoenix, Sacramento, San Antonio, San Juan, and the Washington Field Office.
  - – Strikes decreased 19% in the major metro areas of the field offices (14% elsewhere), campaign extended to June 3 2014; subsequently Nationally!

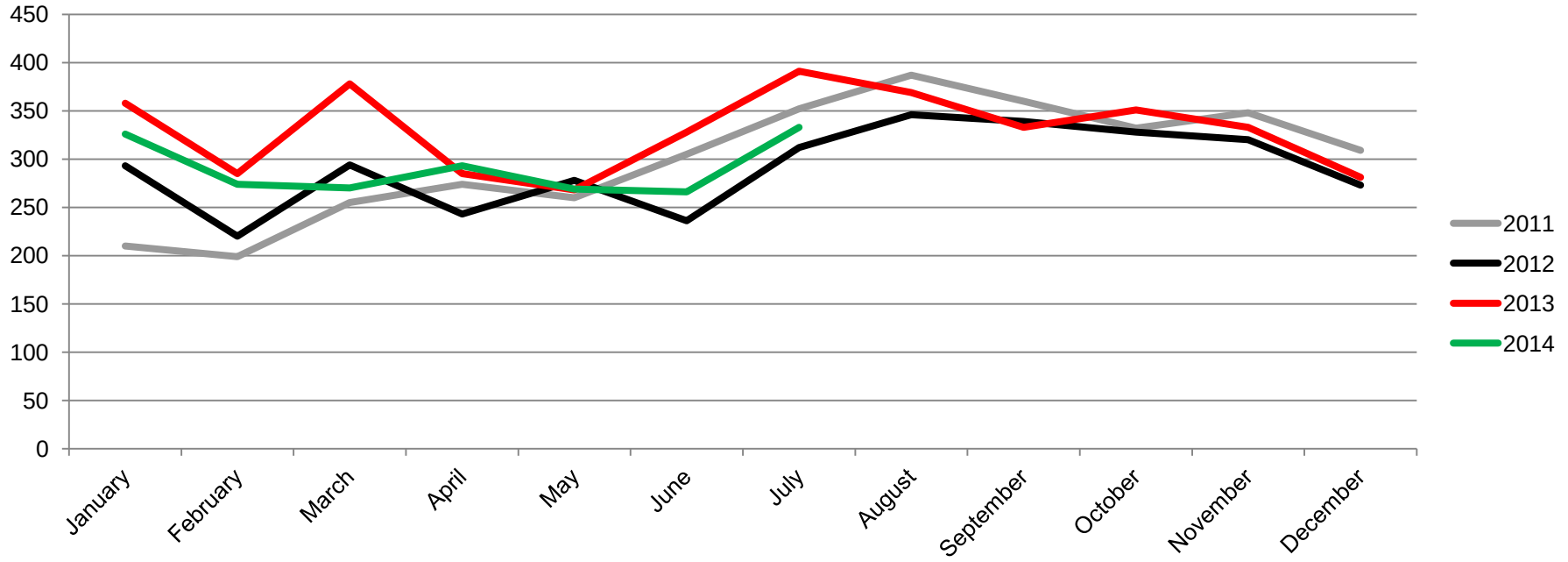


http://www.fbi.gov/news/stories/2014/february/protecting-aircraft-from-lasers

Public Awareness Campaign Cont.

Public Awareness Campaign Cont.

Impact of February 2014 Laser Awareness Campaign

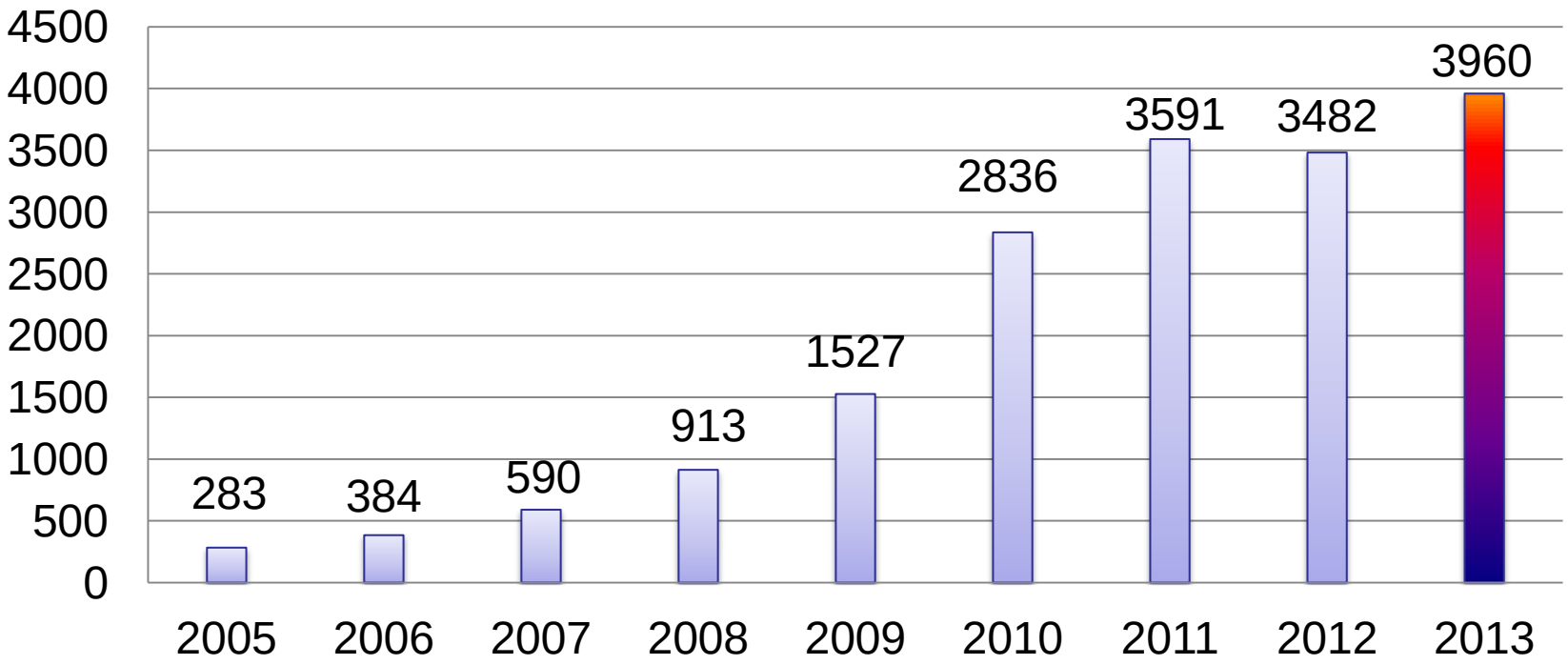


	2011	2012	2013	2014	Grand Total
January	210	293	358	326	1187
February	199	220	285	274	978
March	255	294	378	270	1197
April	274	243	285	293	1095
May	260	278	268	269	1075
June	305	236	328	266	1135
July	352	312	391	333	1388
August	387	346	369		1102
September	360	339	333		1032
October	332	328	351		1011
November	348	320	333		1001
December	309	273	281		863
Grand Total	**3591**	**3482**	**3960**	**2031**	**13064**

Major Metro Areas	2014 11 Feb - 15 May	Daily Avg 11 Feb - 15 May	2013 Totals	2013 Daily Avg	Change
Albuquerque	3	0.03	27	0.07	-57%
Chicago	18	0.19	93	0.25	-25%
Cleveland	2	0.02	24	0.07	-68%
Houston	27	0.29	125	0.34	-16%
Los Angeles	33	0.35	107	0.29	20%
New York	9	0.10	92	0.25	-62%
Philadelphia	4	0.04	55	0.15	-72%
Phoenix/Tuscon	48	0.51	177	0.48	5%
Sacramento	6	0.06	25	0.07	-7%
San Antonio	14	0.15	50	0.14	9%
San Juan	23	0.24	107	0.29	-17%
Washington, DC	3	0.03	31	0.08	-62%
Totals:	**190**	**2.02**	**913**	**2.50**	**-19%**

Analysis of Laser Events by Year

January 2005-October 2013 Totals



35% increase in reported Laser Events from 2005 to 2006

55% increase in reported Laser Events from 2006 to 2007

47% increase in reported Laser Events from 2007 to 2008

61% increase in reported Laser Events from 2008 to 2009

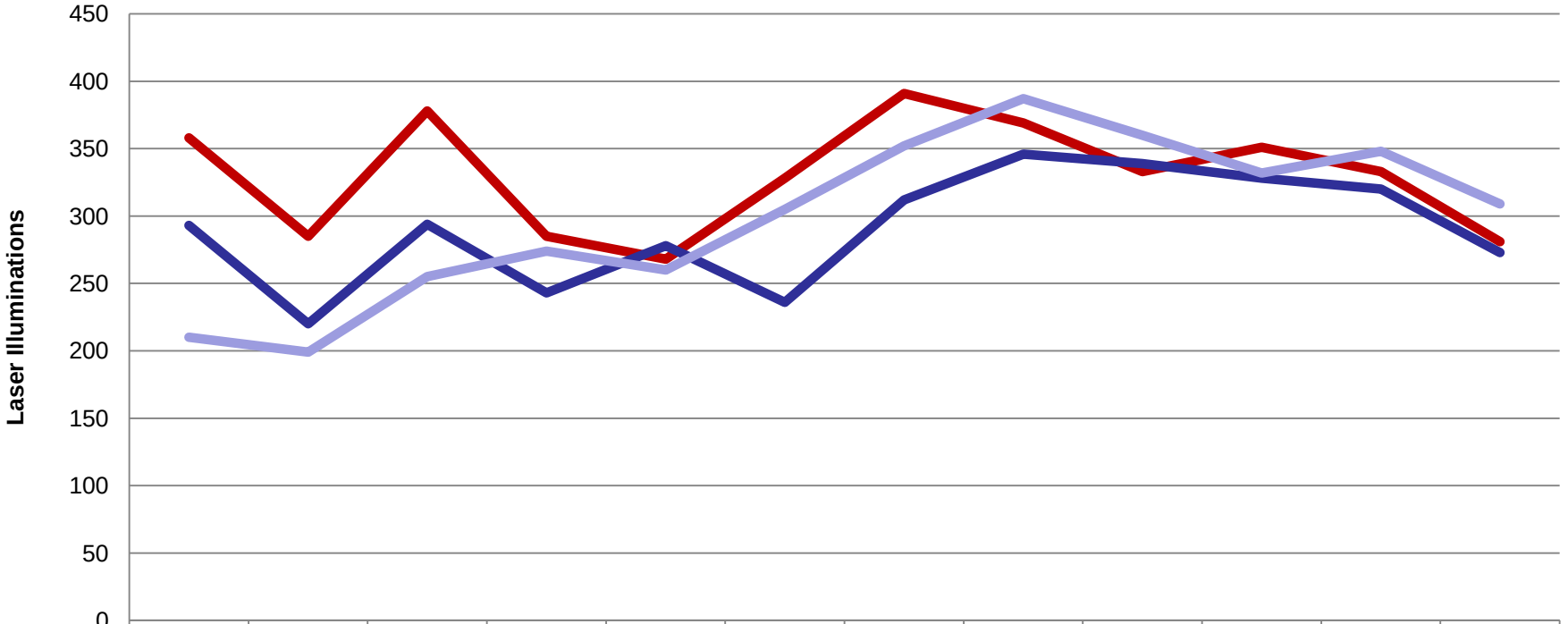
86% increase in reported Laser Events from 2009 to 2010

27% increase in reported Laser Events from 2010 to 2011

14% increase in reported Laser Events from 2012 to 2013

Analysis of Laser Events by Month

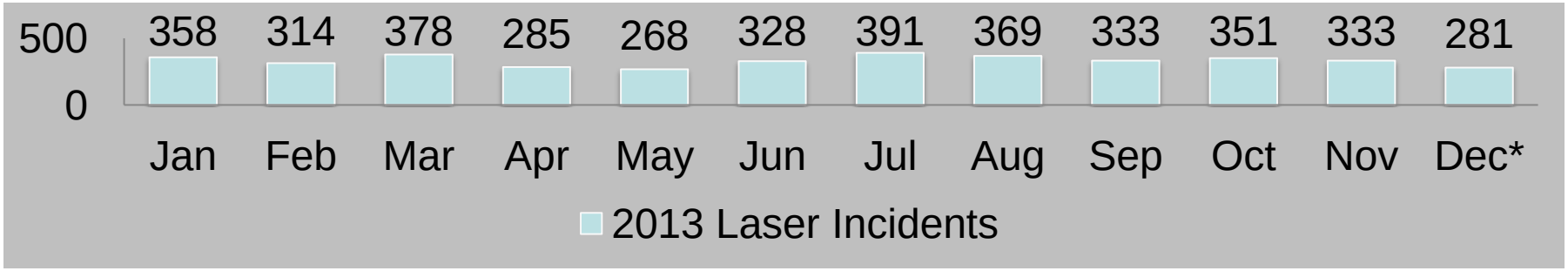
Nationwide Analysis of Laser Events by Month, 2011 - 2013

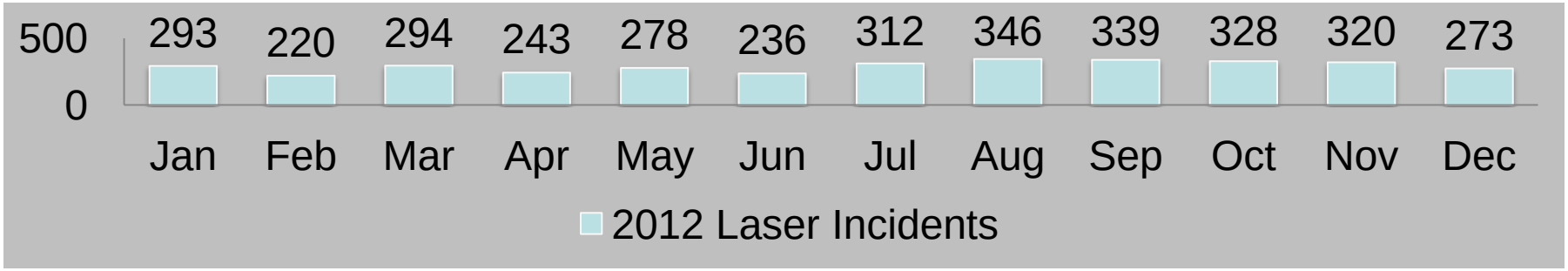


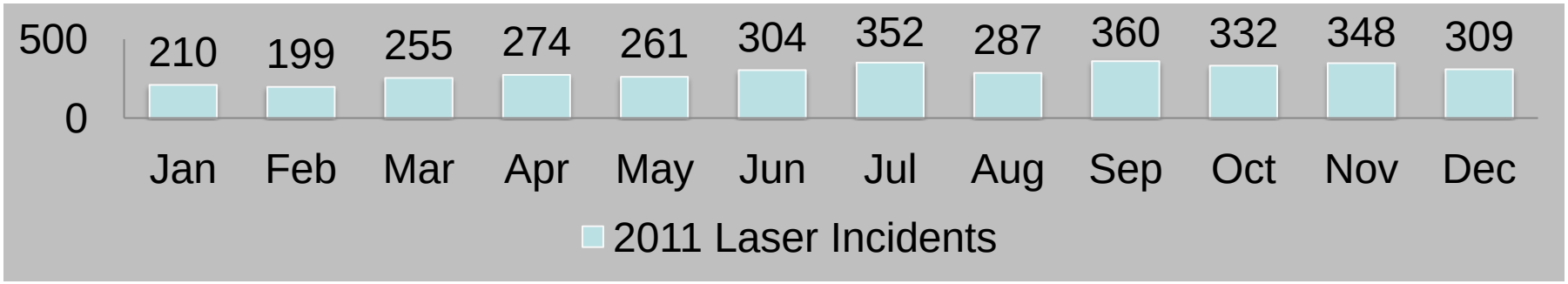
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2013	358	285	378	285	268	328	391	369	333	351	333	281
2012	293	220	294	243	278	236	312	346	339	328	320	273
2011	210	199	255	274	260	305	352	387	360	332	348	309

- **2013 laser illuminations peaked in March and July; least frequent months were April and May.**
- **2012 laser illuminations peaked July – November; least frequent months February, April and June.**
- **2011 laser illuminations peaked in the Summer and, unlike previous years, did not diminish in the Fall.**

Analysis of Laser Events by Month, 2011-2013

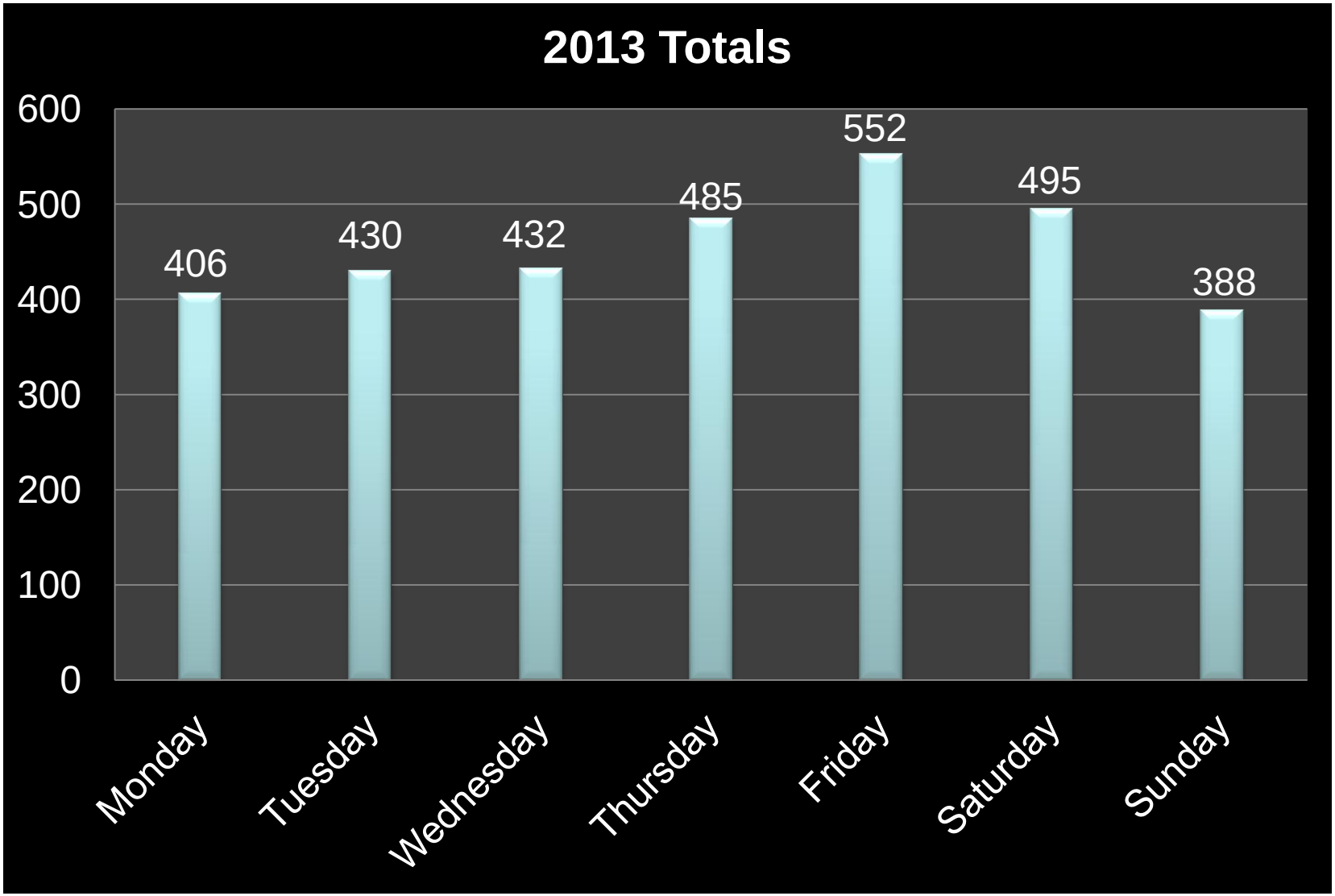






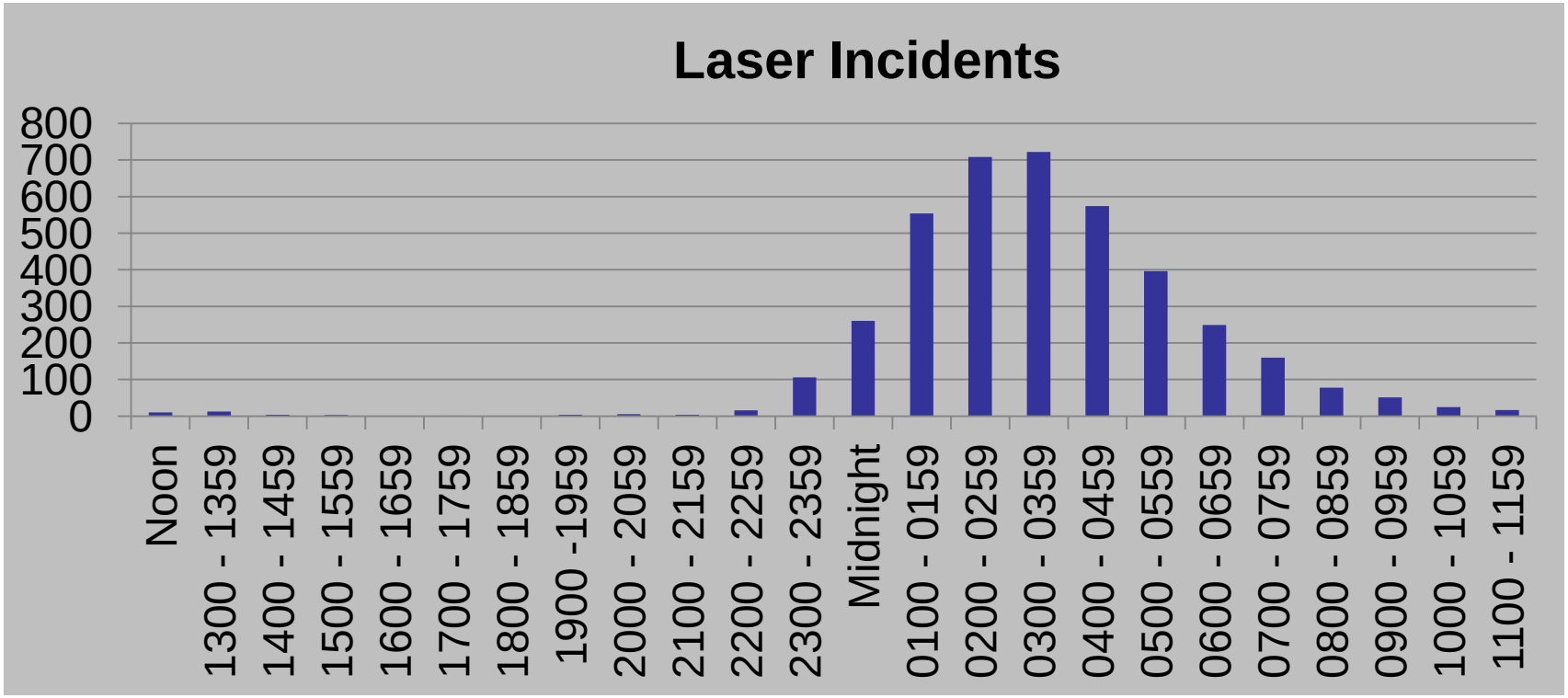
- **Although there was clear seasonality in laser strikes from 2005-2010, recent patterns of illuminations indicate laser events occur year round.**

Analysis of Laser Events by Day of the Week

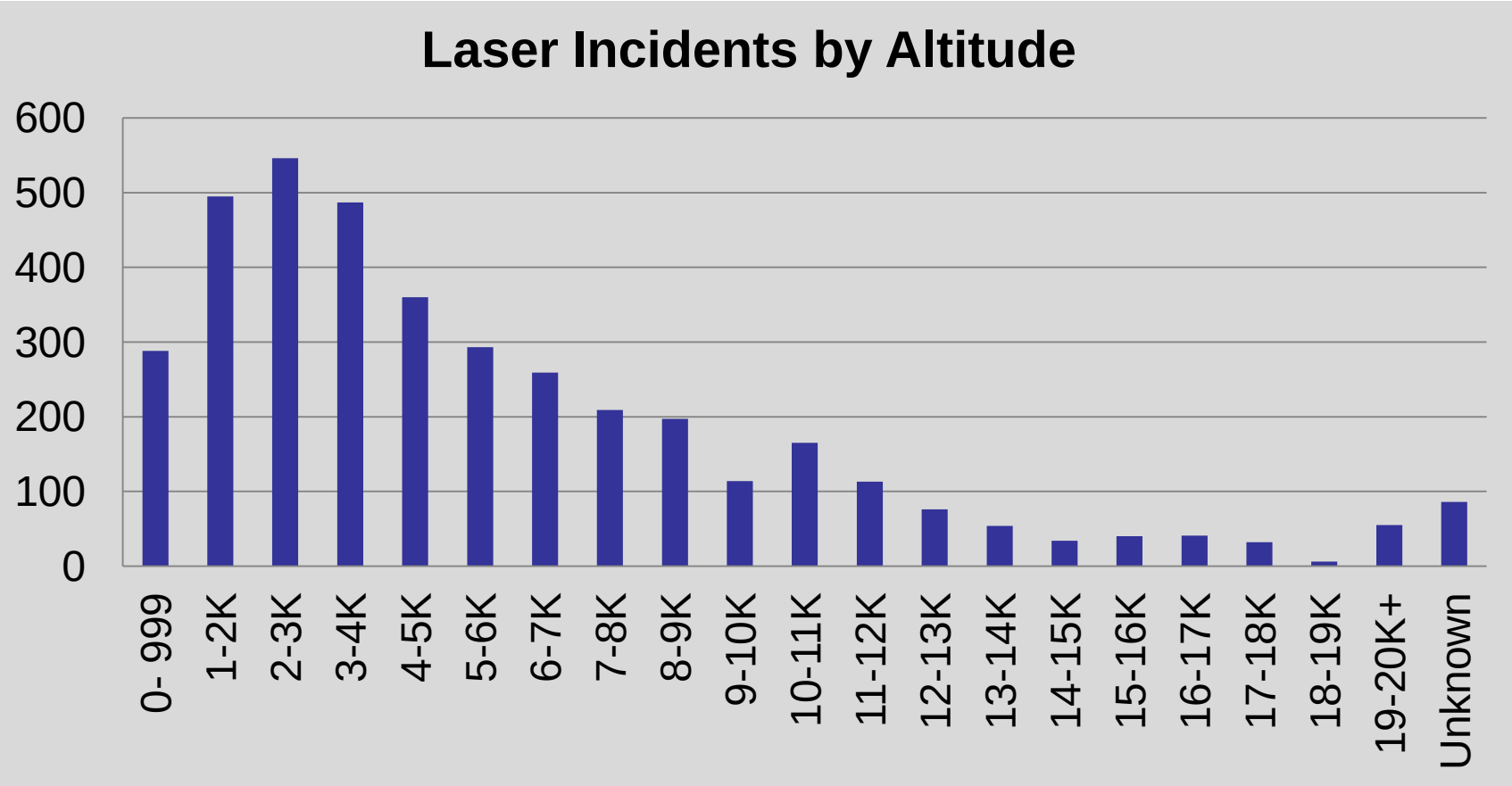


Analysis of 2013 Laser Incidents by Time

- **Laser strikes in 2013 occurred most frequently from Midnight – 0700, with the vast majority of incidents occurring between 0100 – 0500.**
  - **The greatest number of strikes (1430) took place between 0200 – 0359.**
- **This is consistent with 2012 incidents, however a shift from 2011 during which most incidents occurred between 1830 and 2330; with 2200-2300 having the greatest number of incidents.**



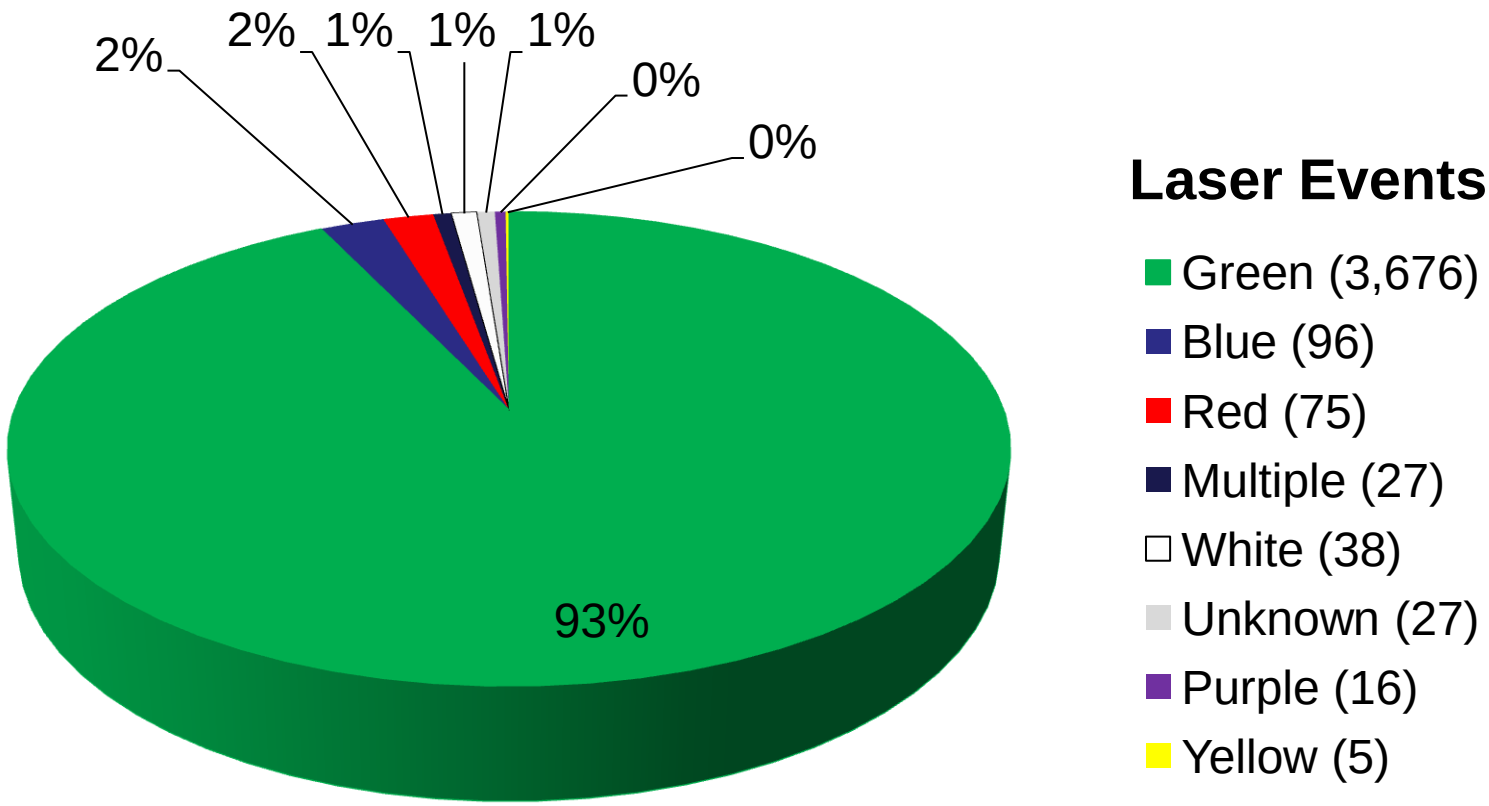
Analysis of 2013 Laser Incidents by Altitude



Landing/Take Off (<3,000 ft) pose greatest risk due to traffic volume, workload and proximity to terrain/populated area.

- Number of laser strikes <3,000 ft in 2013 = 1,328

Frequency of 2013 Laser Light Color



Total Reported Laser Events in 2013: 3960

3,676 (93%) of the 3,960 laser strikes were green

- Green lasers are the most visible to the human eye and offer the greatest potential for adverse vision effects or temporary vision impairment.
- Green lasers are the most readily available.

US Laser Illumination Colors by Year 2004-2013

Year	Green	Blue	Red	White	Yellow	Multi-Colored	Unknown	Totals
2004	16	0	0	3	0	0	2	21
2005	217	6	42	17	0	1	30	313
2006	357	6	20	8	1	10	18	420
2007	545	7	32	14	0	15	32	645
2008	853	4	24	21	1	16	28	947
2009	1363	5	44	25	2	16	34	1489
2010	2643	15	42	17	1	82	37	2836
2011	3366	31	65	48	5	30	30	3575
2012	3270	59	51	31	0	35	36	3482
2013	3676	96	75	38	5	27	27	3960

Problem Worldwide in Scope

European Occurrences

ECA Piloting Safety

European Cockpit Association

Country	2008	2009	2010	2011	2012	2013
Czech Republic	-	20	100+	35*	-	-
Finland	8	15	38	57	44	57 *
France	-	-	600	-	-	-
Germany	-	36	273	279	-	-
Malta	2	4	9	-	-	-
Netherlands	-	270	470	-	550+	-
Norway	5	119	155	98	84	69
Sweden	5	87	128	-	-	-
United Kingdom	178	746	1494	1911	1570	1393

* Estimates based on projections of historical data

Norway CAA website: http://www.luftfartstilsynet.no/flysikkerhetsstatestikk/C_Laser%20interference.htm

Transport Canada Transports Canada

Canada

Problem Worldwide in Scope

Canadian Occurrences

Province	2008	2009	2010	2011	2012	2013
Alberta	-	9	14	23	16	21
British Columbia	-	23	33	38	51	65
Manitoba	-	3	7	8	11	4
New Brunswick	-	0	0	0	1	4
Newfoundland and Labrador	-	0	1	0	2	1
Northwest Territories	-	0	0	0	0	0
Nova Scotia	-	2	4	2	2	2
Nunavut	-	0	0	0	1	0
Ontario	-	57	70	94	153	216
Prince Edward Island		0	0	0	0	0
Quebec	-	13	53	59	73	115
Saskatchewan	-	1	1	6	8	15
Yukon	-	0	0	0	0	0
Yearly Totals	-	**108**	**183**	**230**	**318**	**443**

Transport Canada Transports Canada

Canada

Problem Worldwide in Scope

Canadian Legislation

Aeronautics Act of 2002

- Under Canadian law, it is a federal offence to direct a bright light into the cockpit of an aircraft as it creates a hazard to aviation safety.
- The *Aeronautics Acts*, 7.41 (1) states, “No person shall engage in any behaviour that endangers the safety or security of an aircraft in flight or of persons on board ...” and the Canadian Aviation Regulations Section 601.21 states, “no person shall project or cause to be projected a directed bright light source into navigable airspace in such a manner as to create a hazard to aviation safety or cause damage to an aircraft or injury to persons on board the aircraft.” The maximum penalty for aiming a laser into the cockpit of an aircraft is $100,000, imprisonment of up to five years, or both.
- **Canadian Awareness Efforts:**
  - In 2010, Transport Canada initiated an awareness campaign to bring attention to this issue to potential users of lasers, such as astronomers. The campaign was also directed to local law enforcement agencies to make them aware of their role, and the penalties. Nonetheless, it remains a difficult matter to investigate and enforce.
  - When a laser incident is reported to Transport Canada, the department investigates and coordinates with the appropriate police agency. After sufficient evidence is obtained, the file is referred to the Crown Attorney for legal actions.

2013 States with more than ninety laser events

State	Number of Events
California	736
Texas	418
Florida	328
Arizona	202
Oregon	173
New York	156
Pennsylvania	148
Puerto Rico	115
Illinois	114
Nevada	103
Kentucky	99
Hawaii	95
Colorado	94
Ohio	93

2012 States with more than seventy laser events

State	**Number of Events**
California	541
Texas	363
Florida	298
Arizona	219
North Carolina	141
Pennsylvania	137
New York	131
South Carolina	128
Oregon	117
Illinois	114
Nevada	108
Puerto Rico	75
Ohio	72
Michigan	70

2012 States with more than seventy laser events

State	Number of Events
California	541
Texas	363
Florida	298
Arizona	219
North Carolina	141
Pennsylvania	137
New York	131
South Carolina	128
Oregon	117
Illinois	114
Nevada	108
Puerto Rico	75
Ohio	72
Michigan	70

2011 States with more than seventy laser events

State	Number of Events
California	555
Texas	360
Florida	285
Pennsylvania	239
Arizona	205
New York	184
Illinois	121
New Jersey	115
Virginia	98
North Carolina	91
South Carolina	81
Colorado	79
Hawaii	74
Puerto Rico	73

Top 17 Metropolitan Areas with Laser Events 2013

City, State	Airport Code	Number of Lasers
Portland, OR	PDX	139
Houston, TX	IAH, HOU	126
Phoenix, AZ	PHX	123
San Juan, PR	TJSJ, SJU	107
Los Angeles, CA	LAX	107
Las Vegas, NV	LAS	94
Chicago, IL	ORD, MDW	93
New York, NY	LGA, JFK	92
Honolulu, HI	HNL	69
Miami, FL	MIA	68
Dallas-Ft. Worth, TX	DFW	65
San Jose, CA	SJC	63
Denver, CO	DEN	62
Philadelphia, PA	PHL	55
Tucson, AZ	TUS	54
San Antonio, TX	SAT	50
San Diego, CA	SAN	50

*Locations Selected for Regional Public Awareness and Reward Initiative

Analysis of Top 17 Metropolitan Areas with Laser Events 2013

City, State	Airport Code	Number of Lasers	Change from 2012
Portland, OR	PDX	139	+38
Houston, TX	IAH, HOU	126	+25
Phoenix, AZ	PHX	123	-35
San Juan, PR	TJSJ, SJU	107	+50
Los Angeles, CA	LAX	107	+19
Las Vegas, NV	LAS	94	+11
Chicago, IL	ORD, MDW	93	+20
New York, NY	LGA, JFK	92	+30
Honolulu, HI	HNL	69	+38
Miami, FL	MIA	68	+14
Dallas-Ft. Worth, TX	DFW	65	-21
San Jose, CA	SJC	63	+30
Denver, CO	DEN	62	+30
Philadelphia, PA	PHL	55	+8
Tucson, AZ	TUS	54	+22
San Antonio, TX	SAT	50	+14
San Diego, CA	SAN	50	+16

*Locations Selected for Regional Public Awareness and Reward Initiative

Tools For Prosecution Federal (2008-2011)

- Federal Code(s)
  - Destruction of Aircraft or Aircraft Facilities
    - 18 USC § 32 (a)(5): Whoever willfully interferes with flight / navigation / operations …
    - 18 USC § 32 (a)(8): Whoever willfully conspires to interfere with flight / navigation / operations …
    - Enacted 10/26/2001
    - Penalty: 20yrs/$250,000 fine
- Various State Codes
  - 23 States with Laser Statutes
  - ie. Criminal use or misuse of laser pointers, disorderly conduct, interference with Transportation etc.
  - Historically, easier proof at State level

Tools For Prosecution Federal (June 2011)

14 CFR § 91.11
Interference with a Flight Crew

- The Federal Aviation Administration (FAA) has determined that a laser beam, when aimed at an aircraft by a person who is not on board the aircraft, interferes with a crewmember's ability to perform his or her duties aboard the aircraft, thus violating section14 of the Code of Federal Regulations part 91.11.

- Civil Penalty up to $11,000

Tools For Prosecution Federal (2012)

The 'FAA Modernization and Reform Act of 2012'

- 18 USC § 39 (a) signed into law Feb 14 2012

- **Sec. 39A. Aiming a laser pointer at an aircraft**
  - (a) Whoever knowingly aims the beam of a laser pointer at an aircraft in the special aircraft jurisdiction of the United States, or at the flight path of such an aircraft, shall be fined under this title or imprisoned not more than 5 years, or both.
  - (b) As used in this section, the term `laser pointer' means any device designed or used to amplify electromagnetic radiation by stimulated emission that emits a beam designed to be used by the operator as a pointer or highlighter to indicate, mark, or identify a specific position, place, item, or object.
    - Enacted: 02/14/2012
    - Penalty: 5yrs/$250,000 fine

Successes

- In 2013, there were 80 out of 3,960 incidents where subjects were identified; 101 subjects overall.
  - 74 incidents where law enforcement action was taken.
  - 11 Prosecutions - 2 Federal, 1 State Conviction.
- In 2012 there were 106 out of 3,482 incidents where subjects were identified; 121 subjects overall.
  - 86 incidents where law enforcement action was taken.
  - 26 Prosecutions - 8 Federal, 1 State Conviction.
- 162 Arrests, 132 Prosecutions (97 Federal and 35 State) 87 Convictions since 2004.
- Federal Sentences range from 1 year probation to 14 years in Federal Prison.

2013 Successes

FOX 12 OREGON

Court documents: Surveillance cams helped lead to laser pointer arrest

Posted: Oct 25, 2013 9:16 AM EDT Updated: Nov 22, 2013 9:29 AM EST

By FOX 12 Staff - email

PORTLAND, OR (KPTV) -

A special surveillance team led investigators to a Portland man accused of aiming a laser pointer at planes.

Stephen Bukucs was arrested earlier this month after they says he pointed a laser at planes from his Northeast Portland apartment several times. He's pleaded not guilty.

Court papers show the FBI, Portland police and other agencies conducted a four-plane video surveillance operation this past summer to catch the person responsible. The planes were targeted by green lasers.

Investigators used a combination of surveillance cameras and stakeouts.

They say the trail of evidence brought them to Bukucs' apartment.

The FBI says Portland has one of the highest numbers of reported laser attacks in the country.

2014 Successes

THE UNITED STATES ATTORNEY'S OFFICE
EASTERN DISTRICT of CALIFORNIA

NEWS

United States Attorney Benjamin B. Wagner
Eastern District of California

Laser Striker Sentenced to 14 Years in Prison, Believed to Be the Longest Sentence in a Laser-Strike Case

FOR IMMEDIATE RELEASE

Monday, March 10, 2014

www.usdoj.gov/usao/cae

usacae.edcapress@usdoj.gov

Docket #: 1:13-CR-109 LJO

FRESNO, Calif. — Sergio Patrick Rodriguez, 26, of Clovis, Calif., was sentenced today to 14 years in prison for aiming a laser pointer at Fresno police helicopter Air 1, and attempting to interfere with its operation, United States Attorney Benjamin B. Wagner announced. Calling him a "walking crime spree," United States District Judge Lawrence J. O'Neill said the crime was serious with potentially deadly consequences.

Rodriguez and his girlfriend, Jennifer Lorraine Coleman, 23, were both convicted by a federal jury after a three–day trial in Fresno in December 2013.

According to evidence presented at trial, Rodriguez and Coleman used a high-powered green laser pointer to repeatedly strike the cockpit of Air 1 during a clear summer night in 2012. Air 1 had responded to the apartment complex where Rodriguez and Coleman resided near the Fresno Yosemite International Airport to investigate the report of laser strikes on Air George, an emergency transport helicopter for Children's Hospital of Central California. The laser pointer that Rodriguez and Coleman used was 13 times more powerful than the permissible power emission level for hand-held laser devices. The crew members of both Air 1 and Air George testified that the laser strikes caused significant visual interference.

- FBI and DHS conclude that recent illuminations DO NOT stem from an organized effort to disrupt US air operations.
  - The possibility nevertheless cannot be discounted. (Constant monitoring for Cluster Attacks &/or Message Board traffic)
- To date, no lasing incident has resulted in a plane crash or helicopter crash.
  - Crashes from other bright light sources and close range injuries from lasers have been reported to date.